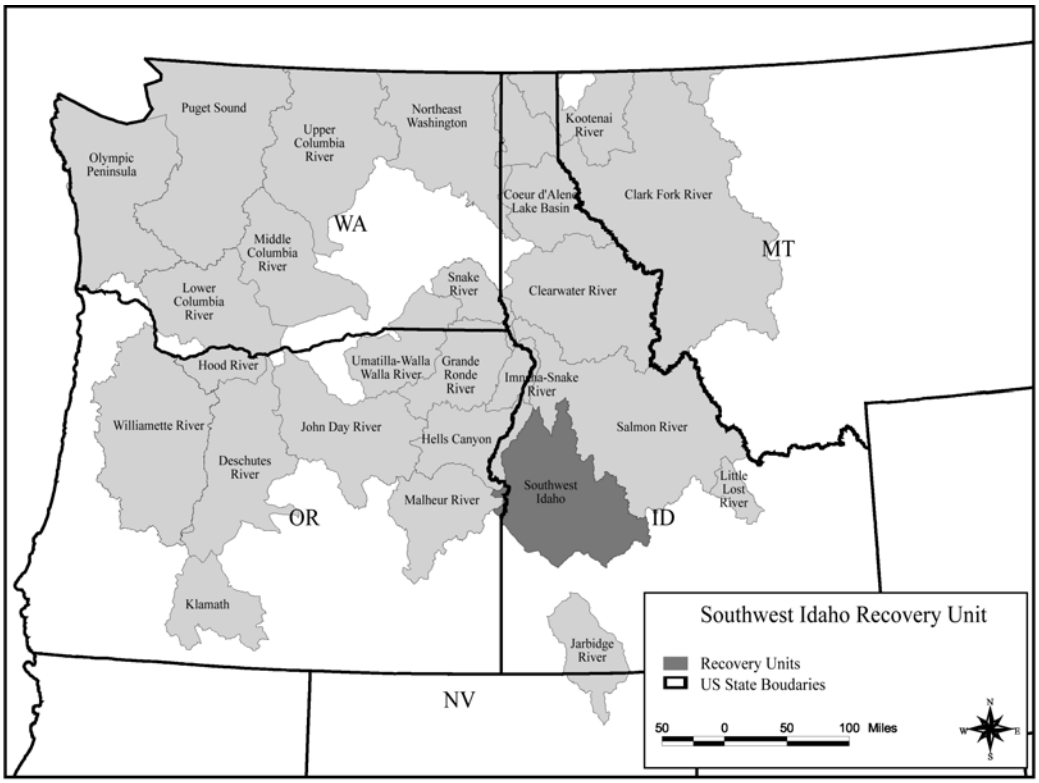
INTRODUCTION

Recovery Unit Designation

The Southwest Idaho Recovery Unit is one of 22 recovery units designated for bull trout in the Columbia River basin (Figure 1). This recovery unit includes the Boise, Payette, and Weiser rivers. Although there were likely no barriers to bull trout moving among the three river basins via the Snake River historically, today bull trout occupy areas in the basins upstream of dams and uninhabitable areas. The basins were included in a single recovery unit because they likely functioned as a unit historically, and they collectively encompass nine key watersheds identified in the Idaho Bull Trout Conservation Plan (Batt 1996). All nine key watersheds are administratively addressed by a single watershed advisory group, the Southwest Idaho Native Fish Advisory Group. However, each river basin is treated as a recovery subunit for organization of this recovery unit chapter and because they are now functionally isolated from each other.

Figure 1. Bull trout recovery units in the United States. The Southwest Idaho Recovery Unit is highlighted.



Geographic Description

The Boise River, Payette River, and Weiser rivers are tributaries to the Snake River, which are entirely within the State of Idaho. The river basins encompass about 2,323,826 hectares (5,742,174 acres) in southwestern Idaho. The Boise River basin contains the largest area (1,038,910 hectares [2,567,147 acres]), followed by the Payette River basin (855,393 hectares [2,113,676 acres]), and the Weiser River basin (429,523 hectares [1,061,351 acres]). The three basins flow south to southwest from mountains in central Idaho. Elevations of the basins range from over 3,048 meters (10,000 feet) in the Sawtooth Mountains to 802 meters (2,631 feet) near the confluence of the Weiser River with the Snake River.

The Southwest Idaho Recovery Unit includes the largest metropolitan area in Idaho, Boise, and the surrounding towns. However, the remainder of the recovery unit is largely rural. Most of the areas currently supporting bull trout in the recovery unit occur on Federal lands (*e.g.,* Boise National Forest, Payette National Forest, and Sawtooth National Forest). In the Boise River Recovery Subunit, over half of the entire area (59.3 percent) is administered by the U.S. Forest Service and Bureau of Land Management (Table 1). A similar percentage of the area in the Payette River Recovery Subunit (56.3 percent) is also managed by the two agencies (Table 2). In the Weiser River Recovery Subunit, about half of the entire area is under private ownership and 43.4 percent is managed by the U.S. Forest Service and Bureau of Land Management (Table 3). In the Boise River Recovery Subunit, headwaters of the Middle Fork Boise River and North Fork Boise River occur in designated wilderness areas. In the Payette River Recovery Subunit, headwaters of the South Fork Payette River and Middle Fork Payette River occur in designated wilderness areas. Forty roadless areas occur on U.S. Forest Service lands in the recovery unit (Stovall 2001).

The Southwest Idaho Recovery Unit has an upland continental climate. Infrequent, but intense, thunderstorms occur during summer and rainfall increases in the fall. November and December are usually the wettest months of the year. Average annual precipitation in the Boise River basin is 508 to 1,270 millimeters (20 to 50 inches) (Steed *et al.* 1998). Based on Snotel (snow telemetry) stations around the basin, the maximum snowfall would be over 1,016 millimeters (40 inches) snow water equivalents in the mountains, and the minimum would be under 381 millimeters (15 inches) in the western portion of the recovery unit.

Geology of the Southwest Idaho Recovery Unit consists primarily of basalt, Idaho batholith, and other granitic formations (Jimenez and Zaroban 1998; Steed *et al.* 1998; Steed 1999; DuPont and Kennedy 2000). Natural erosion rates

vary from easily erodible areas such as in the Boise River and Payette River Recovery Subunits to areas with low or moderate erosion rates such as in the Weiser River Recovery Subunit.

Table 1. Land ownership for the Boise River Recovery Subunit (modified from Stovall 2001).

	Area by 4th-field hydrologic unit code (hectare)[b]				
Ownership[a]	17050111 (N.-Mid. Fks)	17050112 (Boise-Mores)	17050113 (South Fork)	17050114 (Lower Boise)	Total[b]
Military	0.0 (0)	321.2 (0.2)	0.0 (0)	0.0 (0)	321.2 (<0.1)
Private	788.4 (0.4)	33,562.3 (20.9)	45,455.9 (13.5)	260,771.8 (75.7)	340,578.4 (32.8)
State lands	0.0 (0)	23,927.2 (14.9)	14,478.5 (4.3)	15,846.1 (4.6)	54,251.8 (5.2)
USFWS	0.0 (0)	0.0 (0)	0.0 (0)	344.5 (0.1)	344.5 (<0.1)
USFS	195,922.5 (99.4)	95,548.1 (59.5)	267,011.3 (79.3)	4,133.8 (1.2)	562,615.6 (54.2)
BLM	0.0 (0)	4,335.8 (2.7)	4,040.5 (1.2)	45,127.0 (13.1)	53,503.3 (5.1)
USBR	591.3 (0.3)	802.9 (0.5)	3,367.1 (1.0)	14,123.7 (4.1)	18,885.1 (1.8)
Water	0.0 (0)	1,927.0 (1.2)	2,693.7 (0.8)	3,789.3 (1.1)	8,410.0 (0.8)
Total	197,302.2	160,424.4	337,047.1	344,136.2	1,038,909.8

[a] USFWS–U.S. Fish and Wildlife Service, USFS–U.S. Forest Service, BLM–Bureau of Land Management, USBR–U.S. Bureau of Reclamation.
[b] Values in parentheses are percentages.

Hydrologically, peak stream flows typically occur during March through May as a result of snowmelt. Rain-on-snow events usually occur at elevations of 1,372 to 1,524 meters (4,500 to 5,000 feet) or lower. Vegetation within the Southwest Idaho Recovery Unit consist of lands dominated by Douglas fir (*Pseudotsuga menziesii*), subalpine fir (*Abies lasiocarpa*), and ponderosa pine (*Pinus ponderosa*), intermixed with grasses and shrubs; mountain slopes dominated by shrub lands with subalpine fir, Douglas fir, and ponderosa pine; and glaciated areas dominated by lodgepole pine (*P. contorta*) and subalpine fir.

Table 2. Land ownership for the Payette River Recovery Subunit (modified from Stovall 2001).

Ownership[a]	Area by 4th-field hydrologic unit code (hectare)[b]				Total[b]
	17050120 (South Fork)	17050121 (Middle Fork)	17050122 (Payette)	17050123 (North Fork)	
Military	0.0	0.0	0.0	0.0	0.0
	(0)	(0)	(0)	(0)	(0)
Private	3,158.6	6,128.1	186,920.9	91,651.5	287,859.2
	(1.5)	(7.0)	(58.2)	(38.8)	(33.7)
State lands	842.3	4,289.7	19,912.5	29,999.3	55,043.9
	(90.4)	(4.9)	(6.2)	(12.7)	(6.4)
USFWS	0.0	0.0	0.0	0.0	0.0
	(0)	(0)	(0)	(0)	(0)
USFS	197,728.5	71,261.4	45,285.0	97,793.1	412,068.0
	(93.9)	(81.4)	(14.1)	(41.4)	(48.2)
BLM	631.7	1,838.4	65,839.8	2,362.2	70,672.1
	(0.3)	(2.1)	(20.5)	(1.0)	(8.3)
USBR	6,738.4	4,027.1	1,284.7	236.2	12,286.3
	(3.2)	(4.6)	(0.4)	(0.1)	(1.4)
Water	1,684.6	0.0	1,605.8	14,172.9	17,463.4
	(0.8)	(0)	(0.5)	(6.0)	(2.0)
Total	210,784.1	87,544.7	320,848.8	236,215.3	855,392.8

[a] USFWS–U.S. Fish and Wildlife Service, USFS–U.S. Forest Service, BLM–Bureau of Land Management, USBR–U.S. Bureau of Reclamation.
[b] Values in parentheses are percentages.

Fish Species. Within the Southwest Idaho Recovery Unit, anadromous fishes (*i.e.,* chinook salmon (*Oncorhynchus tshawytscha*), steelhead (*O. mykiss*), and perhaps Pacific lamprey (*Lampetra tridentata*)) historically occurred in each of the three river basins; the Payette River basin contained the only sockeye salmon (*O. nerka*) in the upper Snake River basin (Stovall 2001). Construction of impassable dams, first within the basins and later downstream from the confluences of the three basins in the Snake River, eliminated natural runs of anadromous fishes from the recovery unit. The loss of these runs and associated nutrients derived from their carcasses is thought to have negatively affected resident fishes by reducing overall watershed productivity.

Table 3. Land ownership for the Weiser River Recovery Subunit (modified from Stovall 2001).

Ownership[a]	Area by hydrologic unit code 17050111 (hectare)[b] (Weiser)
Military	0.0 (0)
Private	215,836.5 (50.3)
State lands	25,367.2 (5.9)
USFWS	0.0 (0)
USFS	122,966.6 (28.6)
BLM	63,633.1 (14.8)
USBR	430.0 (0.1)
Water	1,289.9 (0.3)
Total	429,523.3

[a] USFWS–U.S. Fish and Wildlife Service, USFS–U.S. Forest Service, BLM–Bureau of Land Management, USBR–U.S. Bureau of Reclamation.
[b] Values in parentheses are percentages
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In the Boise River Recovery Subunit, bull trout found in headwater drainages tend to be associated with fish assemblages of low species richness (Steed *et al.* 1998). These assemblages generally consist of bull trout, rainbow-redband trout (*Oncorhynchus mykiss*), and sculpin (*Cottus bairdi, C. confusus*). In mainstem river and reservoir areas downstream, the fish assemblage is more diverse and includes native species such as mountain whitefish (*Prosopium williamsoni*), northern pikeminnow (*Ptychocheilus oregonensis*), redside shiner (*Richardsonius balteatus*), and several sucker (*Catostomus spp*.) and dace (*Rhinichthys spp*.) species. In addition to hatchery rainbow trout (*Oncorhynchus. mykiss*) and planted chinook salmon, six introduced species are present in the basin; westslope cutthroat trout (*O. clarki lewisi*), kokanee (*O. nerka*), brook trout (*Salvelinus fontinalis*), smallmouth bass (*Micropterus dolomieui*), yellow perch (*Perca flavescens*), and brown bullhead (*Ictalurus nebulosus*).

In the Payette River Recovery Subunit and Weiser River Recovery Subunit, extant native salmonids are bull trout, redband trout, and mountain whitefish (Steed 1999; DuPont and Kennedy 2000; Stovall 2001). Other salmonids, hatchery rainbow trout, cutthroat trout, brook trout, and brown trout (*Salmo trutta*) have been stocked, with stocking dating to the turn of the century. Stocking of rainbow trout, cutthroat trout, and brown trout occurs in some alpine lakes, such as in the Gold Fork River watershed. Other introduced species in the recovery subunits include such species as smallmouth bass, channel catfish (*Ictalurus punctatus*), and common carp (*Cyprinus carpio*).

DISTRIBUTION AND ABUNDANCE

Status of Bull Trout at the Time of Listing

In the final listing rule (63 FR 31647) the U.S. Fish and Wildlife Service identified two bull trout subpopulations in the Boise River basin (Arrowrock Reservoir and Anderson Ranch Reservoir), four in the Payette River basin (Black Canyon Reservoir, South Fork-Middle Fork Payette River, Deadwood Reservoir, and North Fork Payette River), and two in the Weiser River basin (Little Weiser River and East Fork Weiser River) (U.S. Fish and Wildlife Service (USFWS) 1998). Subpopulations were isolated by impassable dams and unsuitable habitat.

At the time of listing (June 1998), insufficient information was available to determine the status (depressed or strong) or trend (increasing, decreasing, stable) of the 8 subpopulations (USFWS 1998). The East Fork Weiser River and North Fork Payette River subpopulations were considered to be at risk of extirpation due to natural events. The U.S. Fish and Wildlife Service considered dams (2 subpopulations), forestry (5 subpopulations), grazing (4 subpopulations), water quality (5 subpopulations), and introduced species (5 subpopulations) to be threats to the 8 bull trout subpopulations in the Boise River, Payette River, and Weiser River basins (USFWS 1998). The magnitude of threats was considered high for 4 subpopulations and threats were considered imminent for 7 subpopulations. Although subpopulations were an appropriate unit upon which to base the 1998 listing decision, the recovery plan has revised the biological terminology to better reflect the current understanding of bull trout life history and conservation biology theory. Therefore, subpopulation terms will not be used in this chapter.

Current Distribution and Abundance

Federal and State resource agencies have documented the occurrence of bull trout throughout the Southwest Idaho Recovery Unit (*e.g.,* Rieman and McIntyre 1995; Corley 1997; Dunham and Rieman 1999; Salow 2001). Distribution of bull trout in the recovery unit comes primarily from presence-absence surveys and basin-wide surveys using electrofishing and snorkeling techniques. Comprehensive data on bull trout abundance through time in the recovery unit does not exist.

Boise River Recovery Subunit. In the Boise River Recovery Subunit, three large dams are impassable barriers to upstream fish movement: Anderson Ranch Dam on the South Fork Boise River, and Arrowrock Dam and Lucky Peak Dam on the mainstem Boise River. Fish in Anderson Ranch Reservoir have access to the South Fork Boise River upstream of the dam. Fish in Arrowrock Reservoir have access to the North Fork Boise River, Middle Fork Boise River, and lower South

Fork Boise River. The upstream portion of Lucky Peak Reservoir is adjacent to the base of Arrowrock Dam. The largest tributary to Lucky Peak Reservoir is Mores Creek, in which bull trout inhabit the headwaters (T. Burton, Boise National Forest, *in litt.* 2000; Boise National Forest, *in litt.* 2002). Upstream of Arrowrock Dam, bull trout have been found in 37 subwatersheds (*i.e.,* 6th-field HUCs) and not detected in 29 others with apparent suitable habitat for spawning and rearing (Steed *et al.* 1998).

Bull trout abundance has been estimated in both Arrowrock Reservoir and Anderson Ranch Reservoir. During 1996 through 1997, abundance of adult migratory bull trout (*i.e.,* fish greater than 300 millimeters (11.8 inches) total length) in Arrowrock Reservoir was estimated at 471 individuals (95 percent confidence intervals were 389 through 590) (Flatter 1998). Mean total length of bull trout was 405 millimeters (standard error was 4.2 millimeters) (15.9 inches, standard error 0.2 inches). The estimate of adult bull trout abundance in 1998 was 354 individuals (95 percent confidence intervals were 133 through 575) with a mean total length of 387 millimeters (standard error was 8.6 millimeters) (15.2 inches, standard error 0.3 inches) (R. Rieber, U.S. Bureau of Reclamation (USBR), pers. comm. 2001). During 1999 through 2000, abundance of adult migratory bull trout in Anderson Ranch Reservoir was estimated at 368 individuals (95 percent confidence intervals were 282 through 454) (Partridge 2000a). Range in total length of fish was 220 through 740 millimeters (8.7 through 29.1 inches).

The abundance of post-spawning adult bull trout that used the North Fork Boise River was estimated using numbers of bull trout marked at a weir in the North Fork Boise River during 1999 and recaptured at the weir in 2000 (Salow 2001). The estimate was 969 individuals (standard deviation was 228), and is biased because it does not account for such factors as varying mortality rates between years, recruitment of juveniles to spawners, straying, and individuals that may spawn in alternate years. Salow (2001) evaluated the effects of hypothetical spawner recruitment and tag loss rates on the abundance estimate and found that both factors, individually and combined, lower the estimate. For instance, post-spawning adult abundance was 385 individuals when a 60 percent immigration (*i.e.,* due to maturation of juvenile bull trout) rate was tested.

Payette River Recovery Subunit. In the Payette River Recovery Subunit, Deadwood Dam created Deadwood Reservoir and forms an impassible barrier to fish movement. Bull trout in the upper Deadwood River and Deadwood Reservoir are isolated from fish in the lower Deadwood River and the South Fork Payette River watersheds. Bull trout in the South Fork Payette River may be able to interact with fish in the Middle Fork Payette River, but a waterfall on the South Fork Payette River (Big Falls) may be a barrier to fish movement (Jimenez and Zaroban 1998). Bull trout inhabiting the North Fork Payette River drainage occur in Gold Fork

River, and are isolated upstream of Cascade Dam and Reservoir, and a diversion dam in the lower Gold Fork River (Steed 1999). Bull trout also occur in North Fork Lake Fork Creek in the North Fork Payette River drainage, but likely in very low abundance (R. Nelson, Payette National Forest, pers. comm.. 2002). Bull trout also occur in headwater reaches of a tributary to the Payette River at Black Canyon Reservoir, Squaw Creek. Bull trout in Squaw Creek are likely isolated from other bull trout in the Payette River basin by irrigation diversions and perhaps high water temperatures (Burton 1999c).

Upstream of Deadwood Dam, spawning and rearing habitat occurs in tributaries to the headwater portion of the upper Deadwood River, Deer Creek, and Trail Creek (Burton 1999b). Resident and migratory bull trout occur upstream of Deadwood Reservoir, however, the abundance of migratory fish is considered low based on observations of large fish in Trail Creek. The U.S. Forest Service estimates that about 1,160 bull trout reside in the drainage upstream of Deadwood Dam (Burton 1999b; Appendix A), and considers the bull trout population in the upper Deadwood River "weak" (*i.e.,* less than 1,500 individuals) and at high risk of extirpation. Low bull trout abundance appears to be related to loss of migratory individuals, isolation, past rotenone treatments, fragmented habitats, and high levels of sedimentation.

In the South Fork Payette River drainage, which includes the Deadwood River downstream of Deadwood Dam, bull trout spawning and rearing is known to occur in watersheds of the upper and middle South Fork Payette River, Canyon Creek, Clear Creek, Whitehawk Creek, and Scott Creek (Jimenez and Zaroban 1998). The U.S. Forest Service considers bull trout in Whitehawk-Scott creeks and Canyon Creek "strong" (*i.e.,* greater than 2,000 individuals with more than 500 adults) with an estimated 3,315 bull trout in Whitehawk and Scott creeks combined, and 2,653 bull trout in Canyon Creek (Burton and Erickson 1999a; Appendix A). Other groups of bull trout in the South Fork Payette River consist of fewer individuals (*i.e.,* 224 to almost 1,500; Appendix A). Most bull trout appear to be residents, but low numbers of migratory fish are also thought to exist (Jimenez and Zaroban 1998).

In the Middle Fork Payette River, bull trout spawning and rearing occurs in the upper portions of the watershed, including the Middle Fork Payette River, Bull Creek, and Sixteen to One Creek (Newberry 2002). Streams that presently do not support bull trout spawning and rearing but may, with restoration, occur elsewhere in the Middle Fork Payette River drainage, such as Lightning Creek and Silver Creek. The U.S. Forest Service estimated bull trout abundance of 2,932 in the upper Middle Fork Payette River and 2,550 in Bull and Sixteen to One creeks combined (Appendix A). Adult bull trout have been found in the lower reaches of the Middle

Fork Payette River suggesting that some migratory individuals exist (Burton 2000a). The distribution of bull trout in critical early life stages appears to be controlled by summer maximum temperatures. Bull trout abundance in Bull Creek appears to be related to brook trout competition, naturally high sediment levels within the roadless area, and few migratory fish.

Surveys conducted during 1991 through 1998 detected bull trout in the Gold Fork River drainage of the North Fork Payette River and in Squaw Creek, a tributary to Black Canyon Reservoir (Steed 1999). The U.S. Forest Service has estimated that about 1,600 bull trout occur in the Gold Fork River (Newberry 2000). Only one or two large fish greater than 305 millimeters (12 inches) have been observed, suggesting that a migratory component may be weak or may no longer exist (Steed 1999). Kennally and Rapid creeks, tributaries to Gold Fork River, contain apparently suitable but unoccupied habitats. The North Fork Kennally Creek and Rapid Creek are largely undisturbed, roadless areas. However, surveys have found high densities of brook trout within the streams. Low bull trout abundance in Gold Fork River appears to be related to brook trout competition, high levels of sediments within potential spawning and rearing habitat, increased drainage network density due to roads, and a migration barrier formed by an irrigation diversion (Burton 1998).

Bull trout have been observed upstream of Cascade Reservoir in the North Fork Payette River drainage (Steed 1999; Faurot 2001). In 1983, bull trout were collected by electrofishing in Fisher Creek and Sater Creek, a tributary to Fisher Creek. No bull trout were observed during snorkel surveys of Fisher Creek by the U.S. Forest Service in 1995, or during electrofishing surveys of Fisher Creek and other streams in the North Fork Payette River drainage by the Idaho Department of Fish and Game in 1998 and 1999. However, three bull trout were observed in North Fork Lake Fork drainage during the latter surveys (Faurot 2001).

In the Squaw Creek drainage, bull trout spawning and rearing occurs in upper Squaw Creek and in Third Fork Squaw Creek (Steed 1999). The U.S. Forest Service has estimated a total of 62 bull trout in Squaw Creek and 2,388 in Third Fork Squaw Creek (Burton 1999c). Bull trout have been observed in the lower reaches of Squaw Creek in recent times, suggesting that a migratory component exists. Low abundance of bull trout appears to be related to high road density and sediment, passage barriers, and brook trout.

Weiser River Recovery Subunit. In the Weiser River Recovery Subunit, bull trout have been found in the headwaters of the Little Weiser River (Anderson Creek, Sheep Creek, and the upper Little Weiser River), the Middle Fork Weiser River, the upper Weiser River (East Fork Weiser River and Dewey Creek) and the

Hornet Creek watershed (Hornet, North, Placer, and Olive creeks) (Adams 1994; DuPont and Kennedy 2000; J. DuPont, Idaho Department of Lands (IDL), *in litt.* 1998; DuPont, *in litt.* 2000). For the Middle Fork Weiser River, McGee *et al.* (2001) noted that a single adult bull trout was observed in 1994 by Hurley (1995) and that anglers have reported catching bull trout in the headwaters. Bull trout were also noted in other areas of the mainstem Middle Fork Weiser River during stream surveys in 1997 (E. Veach, U.S. Forest Service (USFS), *in litt.* 1998). Bull trout were not detected during intensive surveys throughout the Middle Fork Weiser River in 1999 (Williams and Veach 1999), suggesting that bull trout may be extirpated in the drainage (McGee *et al.* 2001).

Most adult bull trout are relatively small in the Weiser River drainage, 100 to 200 millimeters (3.9 to 8.0 inches), and are likely residents isolated most of the year by thermal barriers on the mainstem Weiser River (Adams 1994) or impassible barriers (*e.g.,* at road culverts and water diversions). Adams (1994) found bull trout up to 300 millimeters (11.8 inches) total length in the Little Weiser River drainage. To reach this size, bull trout may have migrated downstream to an area of greater forage production (DuPont and Kennedy 2000). In 1998, the Idaho Department of Lands located a previously unknown population of bull trout along reaches of State lands in Olive Creek, a tributary of Hornet Creek (DuPont, *in litt.* 1998). Fish in this creek were 100 to 180 millimeters (3.9 to 7.1 inches) total length. A culvert formed a fish passage barrier downstream of the bull trout in Olive Creek until it was removed and replaced with a bridge in 1997. Bull trout were also found in Hornet, North, and Placer creeks during additional surveys of State lands in the Hornet Creek watershed during 2000 (DuPont, *in litt.* 2000). No bull trout were over 216 millimeters (8.5 inches) total length. No bull trout were observed during surveys of Forest Service lands in the Hornet Creek watershed during 2000 (Williams 2001).

Adams (1994) estimated bull trout density for various habitat types in study reaches of three streams using daylight snorkel surveys. In Anderson and Sheep creeks, bull trout density was 5.7 and 5.6 fish per 100 square meters (1,076 square feet), respectively, for all habitat types in 1992. Expanding fish density to entire study reaches resulted in estimations of 1,433 bull trout in Anderson Creek and 1,251 in Sheep Creek. In Dewey Creek, bull trout density was 3.2 fish per 100 square meters (1,076 square feet) for pool habitats in 1993. The expanded estimate for the entire study reach was 166 bull trout. DuPont (*in litt.* 2000) estimated bull trout density in the Hornet Creek watershed using single-pass electrofishing surveys. Densities were 4 to 10 fish per 100 square meters (1,076 square feet). Expanding fish density to entire stream reaches suspected to support bull trout resulted in a total estimate of 2,000 to 4,000 individuals.

REASONS FOR DECLINE

Habitat fragmentation and degradation are likely the most limiting factors for bull trout throughout the Southwest Idaho Recovery Unit. Although reservoirs formed by dams in some basins have allowed bull trout to express adfluvial life histories, dams, irrigation diversions, and road crossings have formed impassable barriers to fish movement within the basins, further fragmenting habitats and isolating bull trout. Land management activities that degrade aquatic and riparian habitats by altering stream flows and riparian vegetation, such as water diversions, past and current mining operations, timber harvest and road construction, and improper grazing practices, have negatively affected bull trout in several areas of the recovery unit. Bull trout are also subject to negative interactions with nonnative brook trout in some streams. The following factors contributing to the decline of bull trout in the coterminous United States are discussed relative to bull trout in the Southwest Idaho Recovery Unit.

Dams

In the Boise River Recovery Subunit, three dams (Anderson Ranch, Arrowrock, and Lucky Peak dams) are fish passage barriers. Anderson Ranch and Arrowrock dams are operated by the U.S. Bureau of Reclamation; the U.S. Army Corps of Engineers operates Lucky Peak Dam. A fourth dam, Atlanta Dam, which is owned by the U.S. Forest Service and operated by a power company, was a passage barrier until a fish ladder was constructed and began operation in 1999. Habitats created in the reservoirs formed by Arrowrock Dam and Anderson Ranch Dam have allowed bull trout to express adfluvial life histories.

Anderson Ranch Dam, on the South Fork Boise River, blocks access of bull trout residing in the lower South Fork Boise River, North Fork Boise River, and Middle Fork Boise River to the upper portion of the South Fork Boise River basin. The dam is approximately 100 meters high (332 feet) tall and has no provisions for either upstream or downstream fish passage. Anecdotal information suggests entrainment of juvenile and adult bull trout may occur during spills prior to May 1, or when the pool is reduced to dead storage during September 30 through May 1 (Steed *et al.* 1998). However, of 48 bull trout collected upstream of Anderson Ranch Dam and implanted with radio tags during a study in 1998 and 1999, none were found downstream of the dam (Partridge 2000a). Operation of Anderson Ranch Dam has had a major alteration on stream flow downstream (Steed *et al.* 1998). During low water years (drought), flows are regulated at three levels, 48 cubic meters per second (1,700 cubic feet per second), 17 cubic meters per second (600 cubic feet per second), and 8 cubic meters per second (300 cubic feet per second).

Arrowrock and Lucky Peak dams have had adverse effects on bull trout inhabiting the lower South Fork, Middle Fork, and North Fork Boise River. The dams have no provisions for either upstream or downstream fish passage, and have eliminated access to lower portions of the Boise River basin by migratory fish. Based on bull trout that were radio tagged in Arrowrock Reservoir and later collected downstream in Lucky Peak Reservoir during 1998, Flatter (1999) found that a minimum of 16 percent of the tagged fish were entrained through Arrowrock Dam, which equates to 54 bull trout greater than 300 millimeters (11.8 inches) when extrapolated to include all bull trout estimated in Arrowrock Reservoir. Small bull trout (*i.e.,* less than 305 millimeters (12 inches)) were more likely to pass through Arrowrock Dam than larger individuals.

Without fish passage structures or a trap-and-haul program, bull trout that pass through Arrowrock Dam are restricted to Lucky Peak Reservoir and its tributaries. Bull trout inhabit the upper portion of Mores Creek (Burton, *in litt.* 2000; Boise National Forest, *in litt.* 2002), and extensive surveys for bull trout in tributaries of the Mores Creek watershed are planned. The relations and interactions between bull trout that pass through Arrowrock Dam and those inhabiting the upper portion of Mores Creek are presently unknown. However, preliminary genetic analyses of bull trout inhabiting the headwaters of Mores Creek and elsewhere in the Boise River basin indicate that Mores Creek fish possess levels of heterozygosity similar to other areas, and that there is little evidence of consistent spatial population structuring in the basin (M. Kellett, Boise National Forest (BNF), pers. comm. 2002).

Atlanta Dam is a 14-meter high (45 feet) hydropower facility located on the Middle Fork Boise River a short distance downstream of the town of Atlanta. It has completely blocked access to migratory bull trout since the early 1900s, preventing migratory fish from using the upper Middle Fork Boise River watershed (Steed *et al.* 1998). Upstream of Atlanta Dam, bull trout occur in the upper Yuba River. Passage at Atlanta Dam was recently restored when the Idaho Department of Fish and Game constructed a fish ladder that began operating in 1999.

In the Payette River Recovery Subunit, three major dams have been constructed for hydroelectric generation and irrigation water storage. These include: Deadwood Dam on the Deadwood River, Black Canyon Dam on the mainstem Payette River near the town of Emmett, and Cascade Dam on the North Fork Payette River near the town of Cascade. Other smaller dams have been constructed primarily for irrigation diversions.

Deadwood Dam was built in 1931, primarily for irrigation storage and to supplement late season flows in the Payette River for use at the Black Canyon Dam

hydroelectric facility (U.S. Bureau of Reclamation (USBR) 1998; Jimenez and Zaroban 1998). It is administered by the U.S. Bureau of Reclamation. Deadwood Dam is over 50 meters (165 feet) high, has no provisions for either upstream or downstream fish passage, and has isolated the bull trout population residing in the upper Deadwood River drainage. It is not known whether bull trout in Deadwood Reservoir pass downstream through the dam or over the spillway, and fish surveys conducted in summer 1998 found no bull trout in the Deadwood River immediately downstream of the dam (Jimemez and Zaroban 1998) or to the confluence with the South Fork Payette River. In September 1973, Deadwood Reservoir was completely evacuated for maintenance and repair work on the dam. This released large amounts of silt resulting in high turbidity and low dissolved oxygen levels for several days in the lower Deadwood River and South Fork Payette River (Jimemez and Zaroban 1998).

Flows within the lower Deadwood River are released from Deadwood Reservoir based on irrigation water needs (Jimenez and Zaroban 1998) and water to augment flows for salmon in the lower Snake River basin (USBR 2001). Historically, monthly mean flows ranged from 0.3 cubic meters per second (9.7 cubic feet per second) in fall and winter to 19.1 cubic meters per second (673 cubic feet per second) in spring and early summer (Jimenez and Zaroban 1998). Deadwood Dam is presently operated to maintain a winter flow of 1.4 cubic meters per second (50 cubic feet per second) and a minimum pool of about 62 million cubic meters (50,000 acre-feet), which is believed to be not likely to adversely affect bull trout inhabiting Deadwood Reservoir (USBR 2001). Downstream of Deadwood Dam, summer flows are cooler (*i.e.,* 7 to 10 degrees Celsius [45 to 50 degrees Fahrenheit]) than would naturally occur (USBR 2001) and may affect aquatic organisms (Jimenez and Zaroban 1998). However, summer flows and water temperatures may increase potential rearing habitat during the summer for juvenile bull trout, if present.

Cascade Dam was constructed on the North Fork Payette River primarily for irrigation water storage in 1948. The dam is about 30 meters (100 feet) high and has no provisions for either upstream or downstream fish passage. Gold Fork River is a tributary of Cascade Reservoir. Bull trout inhabiting Gold Fork River occur upstream of an irrigation diversion dam on the lower Gold Fork River. The diversion dam has no provisions for either upstream or downstream fish passage. Therefore, dams have isolated bull trout in the Gold Fork River and restricted access of bull trout from other areas to downstream of Cascade Dam.

Black Canyon Dam was constructed on the mainstem Payette River for irrigation water storage and hydroelectric generation in 1924. The dam is 56 meters (183 feet) high and has no provisions for either upstream or downstream fish

passage. Squaw Creek is a tributary of Black Canyon Reservoir. Although no major dams prevent bull trout inhabiting the upper portions of the Squaw Creek watershed from entering Black Canyon Reservoir, irrigation diversions form barriers to immigrating adults and divert emigrating juveniles into areas with lethal conditions.

In the Weiser River Recovery Subunit, there are numerous water diversions and at least 15 reservoirs in the Weiser River basin (DuPont and Kennedy 2000). Major reservoirs include the Hornet Creek Reservoirs, C. Ben Ross Reservoir, Mann Creek Reservoir, and Lost Valley Reservoir. Reservoirs and water diversions have likely had long-term changes in downstream water temperatures, flow regimes, and sediment distribution within the basin, which has likely produced unsuitable habitat for bull trout. Irrigation ditches and water diversions, such as the Galloway diversion, are common in the lower elevations, (typically less than 1,250 meters (4,100 feet) and have substantially influenced flows in the Weiser River basin. In some instances, streams downstream of water diversions are severely dewatered or dry, which influences riparian vegetation, stream temperatures, and sediment routing. Except for the Hornet Creek Reservoirs, C. Ben Ross Reservoir, and Lost Valley Reservoir, as well as some water diversions, most reservoirs and water diversions are located downstream of potential bull trout habitat.

Forest Management Practices

In the Boise River Recovery Subunit, fires, insects, and nearby timber markets have encouraged the application of numerous forestry practices (Steed *et al.* 1998). These practices include timber harvesting and reforestation, road construction, fire suppression, and other practices associated with forestry. These practices can negatively affect bull trout habitats by increasing sedimentation rates, stream bank and channel instability, and water temperatures; decreasing recruitment of woody debris, canopy shading, and habitat complexity; and altering the hydrologic regime. High sedimentation rates may reduce pool depth and cause channels to braid throughout bull trout habitats, and may reduce egg and larval survival in spawning and rearing habitat.

Roads exist throughout much of the public and private lands in the Boise River basin and have provided access for several activities, including logging and various recreational activities. Past road construction on timber lands of the Boise National Forest has negatively affected bull trout (Steed *et al.* 1998). The primary negative effects of road construction and timber harvest, combined, are increases in sedimentation, fish passage barriers, and habitat degradation (*e.g.,* reduced recruitment of woody debris, filling of pools, increased stream bank and channel instability, and decreased riparian canopy cover). For example, several habitat features important to bull trout (*e.g.,* fine sediment, large woody debris, large pools,

and channel conditions) were not adequately functioning for bull trout in some watersheds of the South Fork Boise River due to moderate and high road densities, passage barriers, and other management activities (Burton and Erikson 1998). Road densities throughout the Boise River basin range from 0 to 2.8 kilometers per square kilometer (0 to 4.5 miles per square mile) in watersheds overall, and 0 to 0.5 kilometer per square kilometer (0 to 1.9 miles per square mile) in riparian habitat areas (Appendix B in Steed *et al.* [1998]). There are over 6,600 culverts and road crossings at streams that may be fish passage barriers to adult or juvenile bull trout throughout the Boise River basin.

Forest management practices, such as fire suppression and timber harvest, are believed by many to have altered fire regime and vegetation composition in areas with certain vegetation types, increasing the intensity of fires and their potential effects on bull trout habitats (*e.g.,* Steed *et al.* 1998). Rieman *et al.* (1997) studied bull trout and redband trout responses to large, intense fires that burned three watersheds in the Boise National Forest. Although the fires were the most intense on record, there was a mix of areas that were unburned and severely burned after the fires. Fish were apparently eliminated in some stream reaches, whereas others contained relatively high densities of fish. Within a few years after the fires and after areas within the watersheds experienced debris flows, fish became reestablished in many reaches and densities increased. In some instances, fish densities were higher than those present before the fires in streams that were not burned (Rieman *et al.* 1997). These responses were attributed to spatial habitat diversity that supplied refuge areas for fish during the fires, the ability of bull trout and redband trout to move among stream reaches, and for bull trout, the presence of migratory fish within the system (Rieman and Clayton 1997; Rieman *et al.* 1997; Burton 2000b).

In the Payette River Recovery Subunit, about 90 percent of the upper Squaw Creek watershed is managed by the U.S. Forest Service, and silvicultural activities such as thinning and timber harvest are practiced (Steed 1999). To support these activities road maintenance and road construction have been conducted. Timber harvest in the Gold Fork River basin has been concentrated in the lower elevation areas of the watershed where timber values are highest and access is easier than at higher elevations. Although early settlers cleared and removed timber, initial entry of the watershed for commercial timber harvest began in the 1930's by the Boise-Payette Timber Company. To facilitate log removal, railroads were constructed along the main Gold Fork River and Kennally, Sloans and Flat creeks. By 1938, most of these basins had been harvested. Factors thought to have negatively affected bull trout in the watershed include timber harvest and associated high road densities, sedimentation, passage barriers, and changes in runoff (Burton 1999c). These

factors have also affected bull trout in other areas of the Payette River basin (*i.e.,* Deadwood River, Middle Fork Payette River, and South Fork Payette River).

In the Weiser River Recovery Subunit, timber harvest and associated road construction has occurred throughout most of the basin. The amount of these activities in some watersheds (*e.g.,* the upper East Fork Weiser River, Middle Fork Weiser River) has likely altered the hydrologic regime from what would occur in an undisturbed condition (McGee *et al.* 2001), resulting in habitat degradation due to such effects as increased stream bed and bank erosion. In the Little Weiser River drainage, large woody debris levels are low in some stream reaches (DuPont and Kennedy 2000). Visual inspections of streams in the watershed indicated that substantial amounts of coarse woody debris (0.9 to 10.7 meters (3.0 to 35.0 feet) in length, 76.2 to 304.8 millimeters (3.0 to 12.0 inches) in diameter) move rapidly through the system and the entire drainage would benefit from higher levels of large woody debris (DuPont and Kennedy 2000). Pool frequency is below U.S. Forest Service (1995) management objectives (*i.e.,* Inland Native Fish Strategy- INFISH) throughout the watershed. The average road density on National Forest lands with bull trout throughout the Weiser River basin is nearly 3.1 kilometers per square kilometer (5.0 miles per square mile) in riparian habitat conservation areas (Stovall 2001).

Livestock Grazing

In the Boise River Recovery Subunit, livestock graze on private, State, and Federal lands; monitoring of grazing forage and riparian habitats is limited (Steed *et al.* 1998). Livestock grazing has occurred in the South Fork Boise River drainage for more than 100 years at a variety of grazing intensities and has had negative effects on aquatic resources (*i.e.,* through reduced riparian vegetation, and increases in sedimentation, stream bank instability, water temperatures). In the last 20 years, sheep have grazed the majority of the area with only about 10 percent of the total area grazed by cattle. Federal cattle allotments are located on the southwestern portion of the drainage and sheep allotments generally on the remainder of the Federal lands. In 1999, the U.S. Fish and Wildlife Service established riparian vegetation standards for grazing allotments to protect bull trout in the Sawtooth National Forest (USFWS 2001a). Some standards have been exceeded and the Forest Service has taken measures to improve compliance (Kenney *et al.* 2001). On private lands, some cattle grazing occurs with relatively high use occurring in the Deer Creek and Grouse Creek watersheds (Steed *et al.* 1998). The effects of improper cattle grazing on riparian habitat are also apparent in the Fall Creek and Little Smokey Creek drainages. Overall, effects of sheep grazing have been moderate to light in the Boise River Recovery Subunit.

In the Payette River Recovery Subunit, there are eight grazing allotments on Federal lands upstream of Deadwood Dam (seven sheep and one cattle) (Jimenez and Zaroban 1998). None of the sheep allotments have been used during the last 15 years. The single cattle allotment is located in the Deer Creek watershed and is grazed on alternate years with light use (Jimenez and Zaroban 1998).

Extensive grazing occurs in the lower third of the Squaw Creek drainage and in the Gold Fork River drainage (Steed 1999). Private lands in the lower portions of Gold Fork River are managed for intensive cattle grazing, especially in the Laffin Well Creek, Kennally Creek, and Flat Creek watersheds. Cattle are also grazed throughout Boise Corporation lands, including an open range cattle allotment. A sheep allotment runs on portions of U.S. Forest Service lands in the Payette National Forest in the Rapid Creek, Camp Creek, and Paddy Creek basins and also in the Gold Fork Meadow area of the South Fork Gold Fork River. Effects of grazing from cattle and, to a lesser extent, sheep, are apparent in the Gold Fork River watershed, particularly in the Sloans Creek, Flat Creek, Kennally Creek, and Middle Gold Fork River drainages.

Timber harvest in the Gold Fork River drainage has created a network of roads and skid trails adjacent to stream channels, providing cattle access to riparian areas (Steed 1999). Cattle trampling has prevented revegetation of skid trails at road and stream crossings, and along alluvial channels. The combined effects of grazing and unvegetated skid trails have resulted in delivery of sediment directly to streams, as well as preventing the reestablishment of riparian vegetation along streambanks and skid trails.

In the Weiser River Recovery Subunit, cattle graze throughout the area. Cattle winter on private lands in the lower elevations and summer on U.S. Forest Service lands during May through October (DuPont and Kennedy 2000). Generally, the upland areas are lightly used and some riparian areas are inaccessible to cattle; however, many meadow areas and stream crossings have been heavily affected by cattle (DuPont and Kennedy 2000). Because most of the private, State, and Bureau of Land Management grazing allotments are at lower elevations, grazing primarily affects bull trout foraging, migrating, and overwintering habitat. However, grazing has degraded bull trout spawning and rearing habitat or reduced riparian vegetation in Olive Creek (DuPont and Kennedy 2000), but monitoring of grazing forage and riparian habitat in the Weiser River Recovery Subunit has generally been limited.

Agricultural Practices

In the Boise River Recovery Subunit, Arrowrock Reservoir, Anderson Ranch Reservoir, and Lucky Peak Reservoir store water used for irrigation of agricultural lands in the lower Boise River basin. These reservoirs are also currently being used for recreation, flood control, and habitat for aquatic species. Habitats created in the reservoirs formed by Arrowrock Dam and Anderson Ranch Dam have allow bull trout to express adfluvial life histories, which was not possible prior to construction of the dams. The reservoirs also provide habitat for introduced fishes that bull trout may prey upon. Overall effects of the dams on bull trout are addressed in the "Dams" section of this recovery plan, however, operation of the dams for agricultural purposes may be negatively affecting bull trout in the reservoirs by entrainment through the dams and reductions in habitat from reservoir drawdowns. In addition, losses of bull trout into irrigation diversions have been documented on Big Smokey and Willow creeks, both in the South Fork Boise River basin (D. Parrish, Idaho Department of Fish and Game (IDFG), pers. comm. 2000).

Crop production, primarily hay and grain, is limited to relatively small areas of private land in the South Fork Boise River drainage (Steed *et al.* 1998). Crop production can affect bull trout by modifying hydrologic regimes, accelerating sedimentation, and introducing agricultural chemicals. However, these effects of agricultural production have not been demonstrated to affect bull trout in the Boise River Recovery Subunit.

In the Payette River Recovery Subunit, the effects of three major dams constructed for hydroelectric generation and irrigation water storage on bull trout (*i.e.,* passage barriers) and bull trout habitat (*i.e.,* flow regime) were discussed under the "Dams" section of this recovery plan. These are Deadwood Dam on the Deadwood River, Black Canyon Dam on the mainstem Payette River near Emmett, and Cascade Dam on the North Fork Payette River near Cascade. Other smaller dams have been constructed primarily for irrigation diversions. Irrigation diversions in the Squaw Creek watershed are suspected to create unsuitable habitat conditions for bull trout (*e.g.,* stream reaches with simplified habitat complexity, elevated water temperatures, and reduced water depths) and may be passage barriers (Steed 1999). An irrigation diversion on the lower Gold Fork River is a fish passage barrier (Steed 1999), and other diversions forming passage barriers exist on streams in which bull trout have been observed in the past (*e.g.,* Lake Fork Creek, Fisher Creek) in the upper North Fork Payette River (Steed 1999; Faurot 2001).

In the Weiser River Recovery Subunit, much of the private lands along streams has been cleared for agricultural purposes and flood control (DuPont and Kennedy 2000). This has reduced or eliminated riparian vegetation, resulting in reduced stream bank stability, large woody debris recruitment, pool habitat, and overall habitat diversity; and likely elevated summer water temperatures and sediment delivery. In some areas, streams were excavated and channelized to reduce flooding of agricultural lands, which has reduced habitat complexity in such areas as the Weiser River from Council to Cambridge and on the Little Weiser River downstream of C. Ben Ross Reservoir. Numerous water diversions have created passage barriers, reduced water quality, and resulted in stream reaches that are often completely dry during peak irrigation periods (DuPont and Kennedy 2000).

About a quarter of the area in the Weiser River basin lies above 1,524 meters (5,000 feet) in elevation, which DuPont and Kennedy (2000) considered likely to have water temperatures conducive to bull trout spawning and rearing. Most agricultural activities occur on private lands at lower elevations (DuPont and Kennedy 2000). Therefore, the effects of agricultural practices on bull trout are largely responsible for the loss of migratory bull trout through degradation of foraging, migrating, and overwintering habitat.

Transportation Networks

In the Boise River Recovery Subunit, past road construction on timberlands of the Boise National Forest has negatively affected bull trout (Steed *et al.* 1998). Within the Boise River basin, road densities in 6th-field HUCs are 0 to 2.8 kilometers per square kilometer (0 to 4.5 miles per square mile), and watersheds with the highest road densities are areas where bull trout typically no longer exist. Some watersheds with high road densities include Beaver Creek in the North Fork Boise River drainage and Feather River in the South Fork Boise River drainage. Bull trout are relatively abundant in some roadless areas (*e.g.,* the headwaters of the Queens River and North Fork Boise River) compared to other areas within the Boise River basin (Steed *et al.* 1998).

In the Payette River Recovery Subunit, the effects of roads on aquatic habitats (*e.g.,* increased sedimentation, reductions in large pools, and migration barriers) are limiting factors to bull trout in the Deadwood River, Middle Fork Payette River, and South Fork Payette River basins (Jimenez and Zaroban 1998). Many of the primary access roads within the Middle Fork Payette River basin were built adjacent to the river or within tributary riparian areas. Roads are in poor condition in much of the basin and road densities vary according to management activity. In the South Fork Payette River basin, roads and stream crossings are the

most common factors influencing bull trout, with the lower South Fork Payette River and Clear Creek having the most degraded conditions.

Although the upper portions of the Squaw Creek watershed are roadless, the road network is primarily adjacent to streams in the lower portion of the drainage and occurs both adjacent to streams and on uplands in the mid-reaches of the drainage (Steed 1999). The Gold Fork River watershed contains a total of 943 kilometers (586 miles) of roads, with an overall mean density of 2.5 kilometer per square kilometer (4 miles per square mile). This includes 174, 311, and 459 kilometers of primary, secondary, and closed roads, respectively (108, 193, and 285 miles). Most primary and secondary roads are surfaced with native materials (*i.e.,* less than 10 percent have been surfaced with gravel). Gold Fork River contains high levels of fine sediment due to the geology of the drainage and road density in some areas.

The Weiser River Recovery Subunit contains over 4,106 kilometers (2,552 miles) of roads (DuPont and Kennedy 2000). Estimates of roads are likely low because some estimates apply only to public lands and may not include all roads. For example, inventories of the Little Weiser River and Middle Fork Weiser River drainages indicate that road estimates may be increased 56 to 70 percent to include nonsystem roads (McGee *et al.* 2001). Roads adjacent to streams in riparian areas are common throughout the Weiser River Recovery Subunit (DuPont and Kennedy 2000). The most common problems with roads on Forest Service lands were ditches on insloped roads, rutted surfaces, eroded banks at crossings, and insufficient drainage (McGee *et al.* 2001), which increases sediment delivery to streams particularly for roads used during wet weather. Mean road density is 2.6 kilometers per square kilometer (4.2 miles per square mile) on Forest Service lands in the Middle Fork Weiser River drainage, and 2.4 kilometers per square kilometer (3.7 miles per square mile) in the Little Weiser River drainage. Overall, the average road density on Forest Service lands throughout the Weiser River basin is nearly 3.1 kilometers per square kilometer (5.0 miles per square mile) in riparian habitat conservation areas (Stovall 2001). Roads cross streams at numerous locations in the basin, and many crossings use culverts that may be complete or partial barriers to fish passage (DuPont and Kennedy 2000).

Mining

In the Boise River Recovery Subunit, mining has historically affected substantial areas of the Boise River basin (Steed *et al.* 1998). Dredge mining (commercial bucket) was conducted in several reaches of all the three forks of the Boise River (south, middle, and north), as well as the Mores Creek watershed. Much of the flood plain in mined reaches was turned, leaving cobble piles and

dredge pools. Although bucket dredge mining has not been performed in decades, piles of dredge tailings and pools are still apparent in some areas.

Lode and other forms of placer mining have also been conducted in the Boise River basin, which included processing materials from both river terraces and active stream channels (Steed *et al.* 1998). Most historic placer mining occurred in the upper South Fork Boise River and Middle Fork Boise River, such as near the Atlanta and Featherville-Rocky Bar areas, and Idaho City (Mores Creek drainage). Less extensive mining activity was conducted in the North Fork Boise River and some of its tributaries. Mining has affected large portions of foraging, migrating, and overwintering habitat. It is uncertain whether potentially toxic chemicals used in these types of mining have affected bull trout and other native fishes.

The Atlanta mining district was a major producer of gold; large dredge piles and tailings are still evident (Steed *et al.* 1998). Materials mined were largely quartz with arsenopyrite (iron-arsenic-sulfide) and gold. Other old mines in the Boise River basin include an antimony mine near Swanholm Peak, and small gold and silver mines in Black Warrior Creek, Little Queens River, and other watersheds. The gold-bearing quartz veins at Rocky Bar are upstream of Anderson Ranch Dam, and large placer deposits are evident near Featherville. Commercial mining is still viable in these areas, with the Atlanta deposits the most likely to be reactivated.

Recreational mining using suction dredges occurs in the Boise River basin. Because suction dredges pass gravel from the streambed over a sluice before depositing material back into the stream, their operation may damage bull trout redds and spawning habitat (Steed *et al.* 1998). Dredge operators are regulated by permits and regulations issued by Idaho Department of Water Resources. There are 34 dredge and 10 nondredge mining claims, permits, or abandoned claims in the Boise River basin (Steed *et al.* 1998). Some areas within the Boise River basin have restrictions on recreational mining to reduce negative effects on bull trout..

In the Payette River Recovery Subunit, placer and tunnel mining were conducted historically in the Deadwood River drainage (Jimenez and Zaroban 1998). It is uncertain whether drainage from the Deadwood Mine is adversely affecting water quality of the Deadwood River. The only active mine operating in the Deadwood River drainage is a relatively small mine in the Wilson Creek watershed (Mary Jane Mine). There are no known precious metal mining activities in the Middle Fork Payette River (Jimenez and Zaroban 1998). Past and current aggregate mining occurs in the lower Middle Fork Payette River. In the Gold Fork River drainage, gold discoveries in the late 1800's led to prospecting near McCall (Steed 1999). Several large pits in the Paddy Flat area appear to be the result of

hydraulic mining. Although extensive drilling to test for monazite deposits occurred in the Gold Fork basin, there is no evidence that dredge mining for monazite has occurred.

In the Weiser River Recovery Subunit, effects of mining are not thought to be a factor affecting bull trout.

Residential Development and Urbanization

Residential development has not taken place throughout much of the the Boise River Recovery Subunit. There are several small communities, such as Atlanta, Featherville, Pine, and Rocky Bar, of which Featherville and the surrounding area is undergoing the most rapid growth (Steed *et al.* 1998). Development in Featherville is largely due to recreation. The majority of private land in the Boise River Recovery Subunit upstream of Arrowrock Dam occurs in the lower (92 percent) and upper (7 percent) portions of the South Fork Boise River.

Although negative effects of residential development on bull trout in the Boise River Recovery Subunit have not been documented, expected effects would be related to development on the flood plain (Steed *et al.* 1998). Residential development typically includes stream channelization and levee construction, which can negatively alter hydraulic characteristics and simplify aquatic habitats. Additional effects include loss of riparian vegetation, road construction and passage barriers, flow alteration, contaminants from household chemicals and seepage from septic systems. Although residential development has not likely been a factor in the decline of bull trout in the Boise River Recovery Subunit, residential development in bull trout habitats increases the likelihood of adverse effects on bull trout.

In the Payette River Recovery Subunit, residential development is not known to have negatively affected bull trout.

In the Weiser River Recovery Subunit, the basin is sparsely populated in the headwaters compared to the lower portions where farm communities occur (DuPont and Kennedy 2000). The two major towns within the basin are Council and Cambridge. General effects of residential development were previously discussed for the Boise River Recovery Subunit. It is thought that these effects may have negatively influenced potential foraging, migrating, and overwintering habitat for bull trout in the Weiser River basin.

Fisheries Management

In the Boise River Recovery Subunit, brook trout have been documented in the three forks of the Boise River basin (Steed *et al.* 1998) and in Mores Creek. In the North Fork Boise River drainage, brook trout have been observed in Meadow Creek, French Creek, lower Crooked River, Beaver Creek, Edna Creek, Pikes Fork Creek, upper Crooked River, lower Bear River, and Bear Creek. Brook trout distribution presently appears to be limited to a relatively small area of the drainage, with most observations in the Crooked River watershed. Hybridization with bull trout has been documented in such areas as lower Crooked River, Bear Creek, and lower Bear River. Brook trout have been documented from the extreme upper portion of the Middle Fork Boise River drainage, such as in Long Gulch and upper Smith Creek. In the South Fork Boise River drainage, brook trout occur in lower and middle Fall Creek, Salt Creek, and Paradise Creek, and they likely occur in other areas. Brook trout in the upper Middle Fork Boise River and South Fork Boise River are thought to have originated from fish introduced in alpine lakes and stocked streams by State and Federal resource agencies and private individuals during the 1940's and 1950's. Hybrids between brook trout and bull trout have been observed in the two drainages.

Hatchery-reared rainbow trout have been and continue to be stocked in the Boise River basin by the Idaho Department of Fish and Game. Transmission of whirling disease from stocked fish to bull trout does not appear to be a factor because bull trout appear to be less susceptible than other salmonids, and the Idaho Department of Fish and Game does not maintain or plant fish that test positive for whirling disease. Numerous nonnative species have been introduced into Anderson Ranch Reservoir and Arrowrock Reservoirs. Species such as kokanee may be used by bull trout as a substitute prey base in place of the anadromous fish that once existed in the basin. Other nonnative species, such as smallmouth bass, may prey on juvenile bull trout. Recreational fisheries for stocked and introduced fish may also expose bull trout to unintended angler mortality.

In the Payette River Recovery Subunit, brook trout are locally abundant in some areas. They have been observed in the upper Middle Fork Payette River (*e.g.,* Bull Creek) (Jimenez and Zaroban 1998) and are present in the Squaw Creek drainage and portions of the North Fork Payette River drainage, such as tributaries to Gold Fork River and Lake Fork Creek (Steed 1999). Brook trout have not been documented in the Deadwood River drainage or in bull trout spawning and rearing habitat in the South Fork Payette River basin (Jimenez and Zaroban 1998). Lake trout have been introduced into Payette Lake (Walker 1998), which may have negatively influenced bull trout in the upper North Fork Payette River.

Numerous nonnative salmonids have been stocked in Deadwood Reservoir, including kokanee, cutthroat trout, rainbow trout, rainbow trout-cutthroat trout hybrids, fall chinook salmon, and Atlantic salmon (*Salmo salar*) (Jimenez and Zaroban 1998). Although stocking species (*e.g.,* chinook salmon and Atlantic salmon) likely to prey on juvenile bull trout has not occurred since 1998, they may have negatively affected bull trout earlier.

Past management activities for the maintenance of Deadwood Dam and to benefit the kokanee fishery in Deadwood Reservoir may have negatively affected bull trout. During August through September 1973, the U.S. Bureau of Reclamation completely evacuated Deadwood Reservoir for repair and maintenance of the dam (Jimenez and Zaroban 1998). During this time, the Idaho Department of Fish and Game treated the reservoir with rotenone and operated Fintrol drip stations in upstream tributaries to eliminate kokanee spawning. The chemical treatment apparently extended downstream of the dam killing several nontarget fishes, including bull trout (Jimenez and Zaroban 1998). In September 1992, the Idaho Department of Fish and Game also applied rotenone to tributaries in the Deadwood drainage (*i.e.,* Trail Creek, Beaver Creek, and South Fork Beaver Creek) to suppress kokanee spawning. Although pre-treatment fish surveys were not conducted, about 40 juvenile bull trout were killed in Beaver Creek (Jimenez and Zaroban 1998). The number of bull trout affected by the treatment was likely underestimated.

The Idaho Department of Fish and Game constructed a migration barrier on the Deadwood River upstream of the reservoir in 1978 to limit access of kokanee to spawning areas (Jimenez and Zaroban 1998). The barrier may have restricted bull trout movement. The barrier was removed in 1980 and replaced with a removable velocity barrier in 1981, which was breached in 1999. A weir is operated at the site to collect kokanee eggs for the Idaho Department of Fish and Game hatchery system on an as-needed basis typically during mid-August through late September, which may be after bull trout have moved upstream to spawn.

In the Weiser River Recovery Subunit, brook trout were widely stocked in the early 1900's and they are established in several areas throughout the Weiser River basin (DuPont and Kennedy 2000). Although a comprehensive survey for brook trout has not been conducted for the basin, brook trout are known to co-occur with bull trout in the upper Little Weiser River, Dewey Creek, and East Fork Weiser River. Hybrids between bull trout and brook trout have been observed in the Little Weiser River and Dewey Creek (Adams 1994). Bull trout are residing at lower elevations in streams lacking brook trout (Sheep, Anderson, and Olive creeks) compared to streams with both species, suggesting that brook trout are influencing the distribution of bull trout (DuPont and Kennedy 2000).

Rainbow trout have been stocked at the Evergreen Campground, Barr Jacobs' Bridge, Ashley Bridge, and at a few other locations throughout the Weiser River basin (DuPont and Kennedy 2000). Rainbow trout distribution overlaps with that of bull trout in the basin. Although rainbow trout are native to the basin, it is uncertain whether the stocked rainbow trout life histories and habitat needs differ from those of the native fish, potentially resulting in competition with bull trout (DuPont and Kennedy 2000). Incidental harvest of bull trout by anglers fishing for rainbow trout may be ocurring.

Isolation and Habitat Fragmentation

In the Boise River Recovery Subunit, dams and some culverts at road crossings are barriers to bull trout movement. Culverts may present unsuitable water velocities in which a fish or certain sizes of fish are unable to swim. Culvertswith perched outlets (*i.e.,* located above the stream channel) may be inaccessible to fish (Steed *et al.* 1998). Depending on the conditions at specific culverts, they may function as partial barriers both seasonally and selectively for fish of certain sizes. Dams and culverts may also cause fish to concentrate downstream where they are vulnerable to predators and anglers. These barriers may not only affect bull trout, but also their potential prey species such as rainbow trout.

The U.S. Forest Service has conducted an inventory of culverts in some watersheds within the Boise River basin (Steed *et al.* 1998). Because of the high numbers of culverts in some areas, such as in the extreme example of the 500 to 600 culverts in the Beaver Creek, Edna Creek, and Pikes Fork watersheds, it is likely that numerous undocumented barriers exist in other areas of the Boise River Recovery Subunit. Culverts thought to be fish barriers have been documented in the Beaver Creek and Owl Creek watersheds in the North Fork Boise River drainage; Swanholm Creek, Cottonwood Creek, and Roaring River watersheds in the Middle Fork Boise River and lower South Fork Boise River drainages; and Fall River, Feather River, Little Smokey Creek, and Trinity Creek watersheds in the upper South Fork Boise River drainage. The overall effects of barriers have likely been a reduction in habitat available to migratory bull trout and reduced interaction of individuals from various portions of the basin (*e.g.,* reproduction and genetic exchange).

In the South Fork Boise River drainage, Idaho Department of Fish and Game conducted a survey of culverts at 105 road crossings and identified 26 that could be potential barriers to fish passage (Partridge *et al.* 2000). Seven of the associated creeks and rivers were considered of sufficient size to support bull trout: Big Water, Fall, Little Water, Steel, Trinity, and Whiskey Jack creeks, and the

Feather River. The culverts on the Feather River (upstream of Featherville) had been previously noted as passage barriers to bull trout (Parrish 1999). However, three migratory bull trout tagged in Anderson Ranch Reservoir were located upstream of the culverts in 1999. In the fall of 1999, three drop structures were built below the culverts to facilitate bull trout passage (Partridge 2000b). An angle-iron structure was also built in one culvert to improve conditions for passage. Overall, passage barriers for bull trout may be particularly detrimental in the upper South Fork Boise River drainage where Anderson Ranch Dam prevents access by fish from the remainder of the basin and has substantially reduced the area of habitat available to fish isolated upstream of the dam. However, Anderson Ranch Reservoir has provided habitat allowing bull trout to express adfluvial life histories.

In the Payette River Recovery Subunit, there are four or five groups (*i.e.,* core populations, see Chapter 1) of bull trout that are essentially isolated due to the effects of various factors. Bull trout are isolated in the upper Deadwood River and Gold Fork River by an impassible (*i.e.,* in the upstream direction) dam and an irrigation diversion, respectively. Additional barriers to fish movement likely exist in the watersheds upstream of these structures due primarily to culverts at road crossings (Jimenez and Zaroban 1998; Steed 1999). Barriers (*e.g.,* irrigation diversions and road crossings) primarily in foraging, migrating, and overwintering habitat, have isolated bull trout in the upper reaches of Squaw Creek. The degree of connectivity between bull trout in the Middle Fork Payette River and the South Fork Payette River is uncertain. Moreover, potential foraging, migrating, and overwintering habitat in the lower Middle Fork Payette River may not be conducive to bull trout due to unsuitable temperature and habitat complexity (*e.g.,* lack of large pools, large woody debris, and appropriate channel form, and excessive sedimentation). Big Falls is a potential natural barrier to fish movement under some flow conditions in the South Fork Payette River; however, adult chinook salmon released in the Payette River have moved above the falls. Because bull trout in each of the groups within the basin are generally in low abundance with few or no migratory fish, the groups are highly isolated.

In the Weiser River Recovery Subunit, several types of barriers to migrating adult and juvenile bull trout exist, such as dams, culverts, water diversions, severely degraded habitat (*e.g.,* subsurface flow and unsuitable water temperature), and natural waterfalls (Dupont and Kennedy 2000). For example, 17 fish passage barriers have been identified associated with 143 kilometers (89 miles) of roads within the Little Weiser River watershed (McGee *et al.* 2001). Similarly, road culverts were identified as passage barriers in the Hornet Creek watershed, which included one each in North Creek and Placer Creek, two in South Fork Olive Creek, and one at the mouth of Grouse Creek (DuPont, *in litt.* 1998, 2000). Bull trout movement in the mainstem Weiser River is inhibited or prevented by excessively

warm water temperatures, human-caused physical and thermal barriers, and dewatered streams (McGee *et al.* 2001).

Construction and operation of reservoirs and water diversions have degraded habitats, which further contributes to bull trout isolation and habitat fragmentation in the Weiser River basin. Typical effects have been long-term changes in downstream water temperatures, flow regime, dewatering, and sediment dynamics in the basin (DuPont and Kennedy 2000). Major reservoirs upstream of either existing or potential bull trout habitats include Hornet Creek Reservoirs, C. Ben Ross Reservoir, and Lost Valley Reservoir. Major water diversions blocking bull trout passage are in the Little Weiser River, West Fork Weiser River, East Fork Weiser River, upper Weiser River, and Hornet Creek watersheds. In the lower portion of the Weiser River basin the Galloway diversion prevents bull trout in the Weiser River from potentially interacting with bull trout from Snake River tributaries in Oregon.

Poor water quality associated with habitat degradation has likely contributed to isolation and habitat fragmentation of bull trout in the three recovery subunits. Under the Federal Clean Water Act, States or the U.S. Environmental Protection Agency designate water bodies that are failing to meet water quality standards (*i.e.,* not achieving their beneficial use) as water quality limited under section 303(d) and are required to develop management plans. The 303(d) lists are published biennually. In 1998, a total of 62 water bodies appeared on Idaho's 303(d) list for the three river basins making up the Southwest Idaho Recovery Unit (*i.e.,* 26, 24, and 12 in the Boise River, Payette River, and Weiser River basins, respectively (Stovall 2001); Appendix B). The most common pollutant for the three basins is excess sediment. Although water quality limited stream segments occur throughout the basins, some reaches coincide with the current distribution of bull trout and have likely contributed to their decline.

ONGOING RECOVERY UNIT CONSERVATION MEASURES

Several activities have been implemented and are ongoing that will improve bull trout distribution, abundance, and their habitats in the Southwest Idaho Recovery Unit. These activities include studies that have and will generate information improving our understanding of bull trout needs, their status, and efficacy of recovery activities.

For proposed Federal activities occurring in the three recovery subunits, the Boise National Forest and Payette National Forest are consulting with the U.S. Fish and Wildlife Service pursuant to section 7 of the Endangered Species Act. During consultations, potential effects of proposed activities on bull trout and their habitats are evaluated, and the activities may be modified to reduce or eliminate negative effects on bull trout. Federal activities often include conservation measures beneficial to bull trout, such as reducing sediment delivery to streams by closing or altering forest roads and grazing practices, providing fish passage by replacing improperly constructed culverts, and conducting fish and habitat surveys (*e.g.,* Faurot 2001; Kenney *et al.* 2001. McGee *et al.* 2001). The current management direction of the two National Forests is guided by objectives contained in INFISH (USFS 1995).

Fish passage barriers have been and continue to be evaluated and addressed in various areas of the recovery unit. In the South Fork Boise River drainage for example, structures were installed in culverts to improve conditions for fish passage in the Feather River (Partridge 2000b), and culverts have been replaced to improve fish passage in other streams in the drainage (*e.g.,* Trinity, Green, Spanish, Johnson Fork, and Whiskey Jack creeks). Culverts have been replaced elsewhere in the other recovery subunits (*e.g.,* Olive Creek in the Weiser River Recovery Subunit). In the Middle Fork Boise River, a fish ladder was constructed at Atlanta Dam to provide bull trout passage. The U.S. Forest Service estimated there are approximately 233 kilometers (145 miles) of bull trout spawning and rearing habitat in the Middle Fork Boise River drainage downstream of Atlanta Dam and approximately 90 kilometers (56 miles) of unoccupied spawning and rearing habitat upstream of Atlanta Dam (Steed *et al.* 1998). Therefore, the fish ladder at Atlanta Dam has increased access for migratory bull trout to 39 percent more spawning and rearing habitat than previously available.

In the Boise River Recovery Subunit, cooperative studies are underway among the U.S. Bureau of Reclamation, Idaho Department of Fish and Game, Boise National Forest, and the U.S. Forest Service Rocky Mountain Research Station to investigate bull trout distribution, movement, and life history. For example, bull

trout movement, abundance, and life history information has been collected in the North Fork Boise River and South Fork Boise River using such methods as weirs and a rotary screw trap. In Arrowrock, Lucky Peak, and Anderson Ranch reservoirs, bull trout abundance was estimated using traps and gill nets, and bull trout movements were estimated using radio telemetry. In tributaries, bull trout distribution and densities were estimated using snorkel and electrofishing surveys; habitat surveys were also conducted, including water temperature monitoring. Various methods to collect bull trout that pass from Arrowrock Reservoir to Lucky Peak Reservoir are being investigated so that fish may be released back into Arrowrock Reservoir. Several of these studies are associated with biological opinions on the operation of U.S. Bureau of Reclamation facilities and the replacement of valves at Arrowrock Dam, which may negatively affect bull trout in the reservoir (USFWS 1999, 2001b). Additional ongoing work includes trap-and-haul of bull trout, genetic investigations, assessments of fish movement and habitats using archival tags and juvenile telemetry, evaluation of conservation pools in reservoirs (*i.e.,* minimum water levels), and the formation of an advisory group to assist in directing and coordinating studies.

The Idaho Department of Fish and Game has also implemented ongoing conservation measures to benefit bull trout. Bull trout harvest has been prohibited Statewide since 1994. Fish use of the ladder at Atlanta Dam will be monitored during August through 2005. The agency has also conducted a brook trout suppression study in a tributary of the North Fork Boise River during 1998 through 2000. In addition, the agency has conducted creel surveys in conjunction with educational efforts to investigate anglers' ability to correctly identify fishes with the goal of improving angler knowledge of fishes and fishing regulations. The intensive program of using signs to inform anglers has been successful in reducing bull trout harvest in the Boise River basin and should be expanded.

Under sections 303 and 304 of the Federal Clean Water Act, states or the U.S. Environmental Protection Agency set water quality standards, which combine designated beneficial uses and criteria established to protect uses. States or the Environmental Protection Agency designate water bodies that are failing water quality standards as water quality limited under section 303(d) and are required to develop management plans. Management plans include total Maximum Daily Loads with implementation plans that define site-specific actions and timelines for meeting water quality goals. A total of 62 water bodies, which is about 1,448 kilometers (900 miles) of rivers and streams, in the three recovery subunits was designed as water quality limited in the 1998 303(d) list for Idaho (Stovall 2001). These water bodies include some stream segments that are currently occupied by bull trout or contain habitat that could be used by bull trout. Total maximum daily loads have been approved by the Environmental Protection Agency for Cascade

Reservoir, lower Boise River, Middle Fork Payette River, and lower Payette River, and Idaho Department of Environment Quality expects to complete plans for other areas in the recovery unit by 2005 and 2006 (Stovall 2001). Ongoing implementation of completed management plans will improve bull trout habitats.

The Natural Resources Conservation Service and the Farm Services Agency administer several programs that provide technical and/or financial assistance, to private landowners to address natural resource issues. Resource management systems are developed with landowners to address soil, water, air, plant, and animal resource concerns. Programs available to private landowners include the Conservation Reserve Program, Environmental Quality Incentives Program, Wetland Reserve Program, and Wildlife Habitat Incentives Program. Resource management systems developed with landowners identify practices that will reduce soil erosion and sediment delivery to streams, restore riparian and wetland functions and values, reduce water consumption on irrigated agricultural lands, and reduce nutrient and pesticide pollution in water bodies. Typical practices implemented include, riparian forest buffers, fencing, use exclusion, irrigation water management, nutrient and pesticide management, prescribed grazing and livestock watering facilities away from streams.